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GMP # 35

MEMORANDUM

TO: District Directors
Environmental Health Managers
Environmental Health Supervisors
Environmental Health Specialists

FROM: David Effert, Technical Services Chief
Division of Onsite Sewage and Water Services

THROUGH: Robert W. Hicks, Director
Office of Environmental Health Services

SUBJECT: Estimated vs. Real Water Use As it Relates To
Soil Absorption Field Design
Onsite - Guidance - Water Use

Introduction

Determining wastewater flows and characteristics is a fundamental first step in successfully designing an onsite wastewater treatment system. Traditionally, "Quantities of Sewage Flow" tables have appeared in textbooks, equipment manufacturer's literature, and in the Manual of Septic Tank Practices (US Public Health Service, 1967). Eventually, state regulatory agencies adopted these flow tables verbatim, or modified existing tables for use based on their own studies and experience. According to the manual entitled Management of Small Flows (US Environmental Protection Agency, 1978), Virginia adopted Table 4.1 of the Sewage Handling and Disposal Regulations (Virginia Department of Health, 1989) based on a mixture of studies and experience.

Typical "Quantities of Sewage Flow" tables were based on estimates of the volume of water needed when designing a water supply. These estimates included supply distribution system leakage, fixture-unit peak flow measurements, and assumptions concerning occupancy patterns, i.e., the assumption that a household consists of two people per bedroom. Extensive studies, summarized by the Environmental Protection Agency (US Environmental Protection Agency, 1978), (US Environmental Protection Agency, 1980) have shown that average total daily water use for individuals is about 40 percent less than commonly referred to water use figures as presented in "Quantities of Sewage Flow" tables. Typical measured water use for both individuals and facilities is also less than the design flow requirements found in sewage flow tables including Table 4.1 of the Sewage Handling and Disposal Regulations.

Table 1 shows typical water use figures for various residential and commercial establishments, as extracted from Management of Small Flows (US Environmental Protection Agency, 1978), vs. sewage flows listed in Table 4.1 of the Sewage Handling and Disposal Regulations (Virginia Department of Health, 1989).

Table 1. Actual Hydraulic Use vs. Virginia Designs Flows

User Unit	Typical Water Use, gpd	VA Design Flow, gpd
residential, per person	46	75
restaurant, per seat	19	50
office/factory, per person	14	15-35
motel, per guest	32	65
theater, per seat	2.6	5.0
hospital, per bed	172+	300

Why The Difference?

Why is there such a dramatic difference between typical measured water use, and the design sewage flows listed in Table 4.1 of the Sewage Handling and Disposal Regulations? There are a number of justifiable reasons for this discrepancy. The typical measured water use values do not take into consideration flow variation between days of use, i.e., unusually heavy water consumption days, allowance made by occasional guests, differences in periods of use, and differences in wastewater characteristics or strength.

The differences associated with wastewater strength is of particular importance for restaurants. Although a restaurant may only generate 20 gallons of wastewater per seat, the strength of the wastewater as measured by BOD and suspended solids can be 2 to 3 times stronger than residential wastewater. All else being equal, a soil absorption field will clog more quickly when a stronger wastewater is being disposed as compared to wastewater of residential strength. To account for the strength of restaurant wastewater, and the resultant increase in the rate of soil clogging, Table 4.1 of the Sewage Handling and Disposal Regulations lists a design loading rate which is 2.5 times the volume of wastewater normally used per restaurant seat. This design loading rate results in the construction of a larger soil absorption field than would normally be associated with hydraulic loading only. The intended result is the installation of a soil absorption field which has approximately the same useable life as that of a residential system.

Design Considerations

The use of safety factors is common place in all aspects of engineering. It would be unwise to design a bridge to support only the weight of a typical 80,000 pound tractor-trailer since it is known that heavier trucks may drive over the bridge. It would be equally unwise to design an onsite wastewater treatment system without including an adequate design factor of safety. The Environmental Protection Agency has also recognized the need for a factor of safety when designing an onsite wastewater treatment system. The EPA allows for either an indirect safety factor, or a more direct and clearly identifiable safety factor. EPA states in its Design Manual - Onsite Wastewater Treatment and Disposal (EPA, 1980), "To account for the potential variability in the wastewater characteristics at a particular dwelling or establishment,

versus that of the average, conservative predictions or factors of safety are typically utilized. These factors of safety can be applied indirectly, through choice of the design wastewater characteristics and the occupancy patterns, as well as directly through an overall factor."

Using Table 4.6

Table 4.6 of the Sewage Handling and Disposal Regulations lists the area requirements, based on square feet of trench bottom area per bedroom, and square feet of trench bottom area per 100 gallons of wastewater. The area requirements listed in Table 4.6 were developed based on the estimated sewage flows presented in Table 4.1 of the Sewage Handling and Disposal Regulations. When these two tables are used in conjunction with one another, a conservative safety factor is indirectly applied in the final design of the soil absorption field. Table 4.6 is the basis for the sizing of onsite wastewater treatment systems in Virginia.

When actual water use figures, or estimates based on field studies at similar facilities are presented for sizing a soil absorption field, a variance to the use of Table 4.1 must be submitted to the commissioner through the local health department. The variance will be evaluated with the understanding that there is a need to apply a direct factor of safety in order for the soil absorption field to be properly sized. In the case of non-restaurant wastewater (households, schools, commercial establishments, etc.), a safety factor of 0.4 times the measured water use figures should be used. In the case of stronger wastewater, i.e., restaurants, a design factor of 1.0 times the measured water use figures should be used. To calculate the design loading rate, multiply the measured or estimated water use figures by 1.4 for wastewater with household strength characteristics. To calculate the design loading rate for restaurants, multiply the measured or estimated water use figures by 2.0. The resultant flow, in gallons per day, is then used in conjunction with Table 4.6 to determine the area requirements for the soil absorption field. A strategy for predicting wastewater characteristics (Figure 1) is attached.

An exception to the design flow criteria in Table 4.1 may also be issued by the local health department as allowed in Section 2.16.C of the Sewage Handling and Disposal Regulations. The local health department may allow up to a 20 percent reduction in the design flow (for residential use) as listed in Table 4.1, if permanent flow reduction devices are installed in all plumbing fixtures. A conditional permit is required. Exceptions are local decisions, and they do not have to be submitted to the commissioner to be implemented.

Conclusion:

Table 4.1 of the Sewage Handling and Disposal Regulations provides design sewage flows which are to be used for the proper sizing of an onsite wastewater treatment system. These design flows are typically greater than the actual volume of wastewater generated from each specified facility. As a result, when used in conjunction with Table 4.6 of the Sewage Handling and Disposal Regulations, a reasonable factor of safety is included in the final design. The design sewage flows presented in Table 4.1 of the regulations should be used in estimating wastewater flows when sizing onsite wastewater treatment system.

If Table 4.1 is not used in the design of an onsite wastewater treatment system, and measured water use figures or estimates are presented for the facility, a variance is required. The review of the variance will be based the data presented. After evaluating the data, a reasonable factor of safety will be applied when determining the size of the soil absorption field. Exceptions may be issued by the local health department for up to a 20 percent reduction in design flows, if water saving devices are installed on all fixtures, and a conditional permit is issued.

References

U.S. Environmental Protection Agency. 1978. Management of Small Waste Flows. Publication Number EPA-600/2-78-173. M.E.R.L. Cincinnati, OH.

U.S. Environmental Protection Agency. 1980. Design Manual - Onsite Wastewater Treatment and Disposal Systems. Publication Number EPA 625/1-80-012. M.E.R.L. Cincinnati, OH.

U.S. Public Health Service. 1967. Manual of Septic Tank Practice. Publication Number 526, U.S. Department of Health, Education and Welfare, Public Health Service, Washington, D.C.

Virginia Department of Health. 1989. Sewage Handling and Disposal Regulations. Richmond, VA.

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